

REMARKS

Claims 1-3, 6-10 and 13-27 are pending in the application. Claims 1-3, 6-10 and 13-27 were rejected. Claims 29, 30 and 32-41 have been withdrawn from consideration by the Examiner as drawn to a non-elected invention and are hereby cancelled without prejudice to further prosecution in a divisional or continuation application.

Claim Objection

The objection to claim 25 has been addressed in accordance with the Examiner's suggestion. Accordingly, withdrawal of the objection is respectfully requested.

Rejections under 35 U.S.C. §103

Claims 1-3, 6-10 and 13-27 were rejected under 35 U.S.C. 103(a) as being unpatentable over US Patent No. 6,569,553 to Koripella et al. ("Koripella") in view of DE 198 41 993.

The claims have previously been amended to focus on a specific embodiment of the present invention in which the claimed microreactor has a silicon substrate material and a catalytic microcombustion integrated heater (chemical heater) in order to simplify the issues in an effort to expedite the present prosecution. The claims have now been further amended to emphasize an aspect the present invention that further distinguishes the claimed invention from the cited art.

As previously discussed, Koripella teaches a fuel processor based on a particular multi-layer ceramic substrate technology. The fuel processor of Koripella is consistently explicitly described with reference to its particular ceramic substrate material and fabrication technology there is no suggestion whatever of the use of an alternative substrate, such as the presently claimed silicon substrate. The nature of the multi-layer ceramic substrate construction is that it enables a construction technique whereby a large number of ceramic layers may be stacked to form complex three-dimensional structures (see e.g., Figs. 1 and 2). However, silicon has certain advantages over Koripella's multi-layer ceramic technology, namely that it has better thermal performance (i.e., higher thermal conductivity) and scalability and single crystal silicon semiconductor fabrication techniques, tools, facilities and expertise developed and highly refined in the semiconductor industry are available for silicon device manufacturing.

DE 198 41 993 (DE '993) discloses a relatively simple silicon microstructure reactor structure having a plurality of flow channels. The channels of the DE '993 reactor are linear, parallel and part of a single process flow path, and are used to increase the catalytic surface area of the reactor to enhance throughput of a single process medium. As noted at page 11, lines 6-

17, a stack of plates with the linear, parallel microchannels on either side is placed in a metal housing to provide the required inlet and outlet for the process medium. This is the only description provided for this aspect of the microreactor.

The pending claims have been amended to recite an important aspect of the present invention: A fully integrated, chemically heated, steam reforming microreactor in a silicon substrate. This is a far more complex device than the reactor disclosed in DE '993 and it is not at all evident from that disclosure, even in combination with Koripella, that such a device could be constructed. Koripella discloses a complex reactor structure with separate flow channels for separate process media flows achieved in a specific multi-layer ceramic approach. Even with the teaching of DE '993, one of skill in the art would have understood that it would not have been possible to simply replicate the Koripella device in silicon. Multi-layer silicon structures are notoriously difficult to fabricate owing at least in part to difficulties in achieving good surface bonding and sealing of separate layers; it is a significant achievement to construct a silicon device of this type having two to three bonded layers of silicon. Sealing between different flow channels is particularly important in the claimed microreactors since there is more than one process medium flowing through the reformer and heater channels, respectively, and these different process media need to be kept separate. This is to be contrasted with the situation in DE '993 in which leakage between channels is not particularly problematic since the same process medium is flowing through all channels. Furthermore, DE '993 does not describe the additional features (inlets, outlets, and in some embodiments porous membranes, etc.) of a fully integrated silicon device, as claimed, and such a device was apparently not attempted. As noted above, DE '993 only makes reference to a metal housing to provide the required inlet and outlet for the process medium. Accordingly, achievement of the claimed device is not a trivial variation on the disclosure of DE '993 in view of Koripella, and it is respectfully submitted that it would not have been obvious to one of ordinary skill in the art at the time of the invention in view of the cited art.

Accordingly, for at least the reasons noted above, it is respectfully submitted that the pending claims, as amended, are allowable over the cited references and withdrawal of the rejections under 35 U.S.C. 103 is respectfully requested.

Conclusion

The claim amendments are made without prejudice to subsequent reintroduction of these claims or of the subject matter to which they are directed in this or a continuation or divisional application. Applicant expressly reserves the right to file such additional applications to further prosecute subject matter disclosed in the present application.

Applicants believe that all pending claims are allowable and respectfully request a Notice of Allowance for this application from the Examiner. Should the Examiner believe that a telephone conference would expedite the prosecution of this application, the undersigned can be reached at the telephone number set out below. If any additional fees are due in connection with the filing of this amendment, the Commissioner is authorized to charge such fees to Deposit Account 12-0695 (Order No. IL-10634).

Respectfully submitted,

A handwritten signature in black ink, appearing to read "Alan H. Thompson", with a long horizontal flourish extending to the right.

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